

REMARKS

Claims 12-32 are pending in the present application. Claims 12-31 are previously presented in the Office Action filed March 10, 2003 and, by this response, claim 32 is added. Support for the additional claim can be found in the specification at least on pages 26-30 and Figure 8. Reconsideration of the claims is respectfully requested.

I. Specification

The Office Action objects to the amendment to the specification filed on March 10, 2003 under 35 U.S.C. § 112, first paragraph, because it allegedly introduces new matter into the disclosure. Attached is a copy of the amendment received by the Patent Office. From this copy, it is apparent to the Applicants that some of the words that were stricken through did not appear struck through due to the Response having been filed by facsimile. In a September 29, 2003 telephone conversation with Examiner Chen, she was not sure how to remedy this situation. Thus, Applicants assume the paragraph to be as shown in the copy attached and have based the current amendments on this assumption. The current amendments place the paragraph in the format intended by the previous response. With the paragraph in this format, no new matter has been added to the specification. Accordingly, Applicants respectfully request withdrawal of the objection to the specification.

II. 35 U.S.C. § 112, First Paragraph

The Office Action rejects claims 12-31 under 35 U.S.C. § 112, first paragraph, as allegedly containing new matter which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor(s), at the time the application was filed, had possession of the claimed invention. This rejection is respectfully traversed.

As to claims 12, 19 and 26, the Office Action states:

The examiner regards the followings as new matter: “a range of the virtual address space” [e.g., see claim 12, lines 9-10], and the mechanism to associate the claimed “a range of the virtual address space” to each data entry in each layer of the generated hierarchical data storage structure. In addition, “a correlation schema” [e.g., see claim 12, line 13] with “data entry in the lowest layer corresponds to both a virtual address range in the virtual address space and a block address corresponding to a physical data block in the at least one data storage device” as claimed (e.g., see claim 12, lines 14-16).

Office Action dated May 15, 2003, pages 3-4.

Claim 12, which is representative of the other rejected independent claims 19 and 26 with regard to similarly recited subject matter, reads as follows:

12. A method for mapping a virtual address space into block addresses of at least one data storage device, the method comprising:
generating a hierarchical data structure in a primary storage;
wherein the hierarchical data structure includes a plurality of layers arranged according to a hierarchy;
wherein the plurality of layers include at least a highest layer and a lowest layer;
wherein each layer in the hierarchical data structure includes at least one set of data entries;
wherein each data entry in each layer represents a range of the virtual address space;
wherein for each layer in the hierarchical data structure for which there exists an next lowest layer, each data entry is correlated to a set of data entries in the next lowest layer according to a correlation scheme;
wherein each data entry in the lowest layer corresponds to both a virtual address range in the virtual address space and a block address corresponding to a physical data block in the at least one data storage device;
wherein each data entry contained within the primary storage corresponds to a virtual address range that is currently occupied with stored data, such that none of the data entries corresponds to only unused physical storage; and
wherein each physical data block in the at least one data storage device contains virtual address information that identifies at least one corresponding location in the virtual address space for that physical data block. (emphasis added)

Applicants respectfully submit that the specification as originally filed provides an example for “a range of the virtual address space”. On page 26, lines 25-27, the specification reads as follows:

The present invention may also further include a range of data wherein the range of data management is correlated to the layer of the mapping tables addressed.

As stated in the claim, each data entry in each layer represents a range of the virtual address space. This section of the specification refers to the range of data that is correlated to the layer of the mapping tables addressed. As the invention relates to “Dynamically Changeable Virtual Mapping Scheme”, it would be reasonable to convey to one skilled in the art that each data entry in each layer represents a range of the virtual address space.

As a further example, on page 27, lines 11-13, the specification refers to the description of the size of the data units mapped may be by way of a pointer with an address range or a pointer with a unit size. The address range is a range in the virtual address space.

Additionally, “correlation scheme” also has an example within the specification. On page 26, line 25, to page 27, line 3, the specification reads as follows:

The present invention may also further include a range of data wherein the range of data management is correlated to the layer of the mapping tables addressed. The coordination may be, for example, an algorithm, via a pointer system, via a pointer to correlation logic or via a tree structure. The range of data managed may also be independent of the layer of the tables accessed.

As stated in the claim, each data entry is correlated to a set of data entries in the next lowest layer according to a correlation scheme. This section of the specification refers to the data entry being correlated to a layer within the mapping table. In addition the coordination of the correlation may be an algorithm, via a pointer system, via a pointer to correlation logic or via a tree structure, which would be known to one skilled in the art as a scheme.

Furthermore, “each data entry in the lowest layer corresponds to both a virtual address range in the virtual address space and a block address corresponding to a physical data block in the at least one data storage device” has support in the specification from page 28, line 6 to page 30 line 21 and Figure 8. In this section and figure, a description of how the data entry in the lowest layer corresponds to an address space within the LUN

table correlates to a virtual address space within the vector table and the corresponding block address, which relates to the physical data within the storage device.

Regarding claims 16, 23 and 29, the Office Action states:

The Examiner regards the following as new matter: “virtual address range of a homogeneous size”.

Office Action dated May 15, 2003, pages 4.

Claim 16, which is representative of the other reject independent claims 23 and 29 with regard to similarly recited subject matter, reads as follows:

16. The method of claim 12, wherein at least some of the data entries in each layer represent virtual address ranges of a homogeneous size corresponding to that layer.

Applicants respectfully submit that the specification as originally filed provides an example for “virtual address ranges of a homogeneous size”. On page 5, lines 13-15, the specification identifies that the RAID subsystem requires all units to be homogeneous. Additionally, Figure 11 and the corresponding description on pages 32-36 describe a subsystem that maintains a logically consistent address within the RAID, which is homogeneous.

It should be appreciated that the above cited sections of the specifications are only meant to illustrate where support may be found for the claimed features. The claimed invention is not limited to the examples set forth in the specification. The examples are cited as illustrating how the present description conveys to one of ordinary skill in the art that the Applicant had possession of the claimed invention at the time the application was filed.

Therefore, Applicants respectfully submit that the specification provides the subject matter of claims 12-31 such that it conveys to one of ordinary skill in the art that Applicants had possession of the invention recited in claims 12-31 at the time of filing. Thus, the rejection of claims 12-31 under 35 U.S.C. § 112, first paragraph, has been overcome.

III. 35 U.S.C. § 112, Second Paragraph

The Office Action rejects claims 1-26¹ under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter, which applicants regard as the invention. This rejection is respectfully traversed.

As to claims 12, 19, and 26, the Office Action states:

Line 1, it is uncertain what the claimed “primary storage” refers to? [i.e., Does it refer to the storage of the host system? Or those in the network systems? Or others?]. Furthermore, at lines 14-15, it is not understood what is meant by “a virtual address range in the virtual address space” [i.e., What is the scope of the claimed virtual address space? It is unclear how to classify the scope of the claimed virtual address space into the claimed range?]. In addition, at lines 17-19, it is unclear what are the links among the claimed each data entry in the primary storage, virtual address range and the unused physical storage.

Office Action dated May 15, 2003, pages 3-4.

Applicants respectfully submit that the questions posed by the Examiner in this rejection are not directed to any ambiguity with regard to the claimed scope but rather, are questions directed to the manner by which the invention operates. The claim is clear as written.

Whether or not the primary storage is in a host system, a network system or some other architecture is irrelevant to whether the claims are clear or not. All that claims 12, 19 and 26 recite with regard to a “primary storage” is that a hierarchical data structure is generated in a primary storage and each data entry in the primary storage corresponds to a virtual address range that is currently occupied with stored data. Whether the primary storage is in a host, a network, or somewhere else, has no bearing on the scope of claims 12, 19 and 26.

Similarly, the phrase “a virtual address range in the virtual address space” is clear on its face. A virtual address space is a domain of virtual addresses. A range of virtual addresses in a virtual address space is a set of virtual addresses within the domain of virtual addresses. There is nothing unclear about this. One of ordinary skill in the art is well aware of what this phrase means and the scope implied by the use of the phrase.

Furthermore, Applicants respectfully submit that the specification as originally filed provides an example of a “primary storage” on pages 24-28 and in Figure 7 of the specification. The description provides for storage subsystems, which include primary storage and secondary storage and describes how tables can be moved from secondary storage into primary storage. It should be appreciated, however, that these are only exemplary embodiments and the claims are not to be limited to these exemplary embodiments.

As to the links among the claimed data entry in the primary storage, virtual address range and the unused physical storage, from the claim it is clear that (1) each data entry represents a range of virtual addresses; (2) each data entry in the layer having a next lower layer is correlated to a set of data entries in the next lower layer; (3) each data entry in the lowest layer corresponds to both a virtual address range and a block address corresponding to a physical data block; and (4) each data entry contained in the primary storage corresponds to a virtual address range that has data stored in it such that none of the data entries correspond to only unused physical storage. There is nothing unclear about these features. The link between data entries and virtual address ranges is spelled out in the claim. The link with regard to unused space is that no data entry corresponds to only unused physical storage; i.e. some data is stored in each range of virtual addresses corresponding to each data entry.

Furthermore, the specification provides an example of the relationship of these elements in Figures 9 and 10 and the related description of those figures on pages 30-32. On these pages, and in the figures, is a description where the mapping table, which describes the address ranges, makes use of hashing algorithms. The hashing algorithms produce hashed address value outputs, which in turn are input into pointer tables, which are the physical storage. The hashed address value output and the pointer table are held consistent with respect to the virtual address range. Thus, it would be reasonably understood to one skilled in the art that each data entry contained within the primary storage corresponds to a virtual address range that is currently occupied with stored data, such that none of the data entries corresponds to only unused physical storage.

¹ The Office action rejects claims 1-26 under 35 U.S.C. § 112, second paragraph, however, claims 1-11 were canceled in the Response dated March 10, 2003.

As to claims 16, 23 and 29, Applicants respectfully submit that the word “homogeneous” means of the same or similar nature. Thus, the phrase “homogeneous size” means the same size. There is nothing unclear about this. It is not necessary for Applicants to set forth the “criteria” used to define the homogeneous size nor is it necessary for Applicants to state the advantages of having homogeneous size. These are not questions directed to the scope of the claim but are directed to the implementation of the invention as set forth in the specification.

Furthermore, the specification as originally filed provides an example of “virtual address ranges of a homogeneous size”. As stated above, page 5, lines 13-15, of the specification identifies that the RAID subsystem requires all multiple logical units to be homogeneous. Additionally, Figure 11 and the corresponding description on pages 32-36 describe a subsystem that maintains a logically consistent address within the RAID, which has to be homogeneous.

Therefore, Applicants respectfully submit that the specification clearly points out the subject matter which the Applicants claim as the invention in claims 12-26 is clearly recited in the claims and there is no ambiguity with regard to the scope of these claims. One of ordinary skill in the art is clearly apprised of the scope of the subject matter recited in the claims and no clarification of the claims is necessary. Thus, the rejection of claims 12-31 under 35 U.S.C. § 112, second paragraph, has been overcome.

IV. Conclusion

It is respectfully urged that the subject application is now in condition for allowance.

The Examiner is invited to call the undersigned at the below-listed telephone number if in the opinion of the Examiner such a telephone conference would expedite or aid the prosecution and examination of this application.

Respectfully submitted,

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